

DRAFT

Quality Assurance/Quality Control Plan: Samples and Manual for Development

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INVENTORIES (EUROPE/CIS REGION) PROJECT RER/01/G31**

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1. Introduction

One of the primary goals of the inventory development is to work continually to improve emission estimates. One of the most important tasks is to develop a comprehensive and unified approach to managing quality in the inventory estimates including methodological advances, improvements in documentation and clarity to facilitate transparency. Quality control (QC) and quality assurance (QA) should all be integrated into one comprehensive greenhouse gas inventory system. This paper is intended to facilitate QA/QC activities for Europe/CIS region countries under the project “Capacity Building for Improving the Quality of Greenhouse Gas Inventories”, including development of QA/QC plan.

The document provides a set of procedures for maximizing the quality of the inventory given the resources available by describing data and methodology checks, processes governing peer review and public comments.

Quality control and quality assurance must be integrated into every step of the inventory development process. Thus, undertaking checks and procedures at every stage of estimation and document development, involving the experts on an ongoing basis, maintaining an open and transparent inventory process, using multiple review processes, and providing for communication and feedback across the participants in the inventory are all part of quality control and improvement. The document also contains information feedback loops and provides for corrective actions that are designed to improve the inventory estimates over time.

It should be noted that proposed approach is not a rule, but an advised sample. The intent is to lighten decision making for inventory team taking into account national circumstances, availability of financial and human resources etc.

Principally this paper is grounded on two documents: (1) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (here referred to as IPCC Good Practice Guidance) and (2) *Quality Assurance/Quality Control and Uncertainty Management Plan for the U.S. Greenhouse Gas Inventory: Procedures Manual for Quality Assurance/Quality Control and Uncertainty Analysis*.

DEFINITION OF QA/QC

Quality Control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

- (i) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- (ii) Identify and address errors and omissions;
- (iii) Document and archive inventory material and record all QC activities.

QC activities include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardised procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Reviews, preferably by independent third parties, should be performed upon a finalised inventory following the implementation of QC procedures. Reviews verify that data quality objectives were met, ensure that the inventory represents the best possible estimates of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the QC programme.

IPCC Good Practice Guidance

2. Quality Assurance/Quality Control Plan

QA/QC plan is a fundamental element of a QA/QC system. The plan should, in general, outline QA/QC activities that will be implemented, and include a scheduled time frame that follows inventory preparation from its initial development through to final reporting in any year. It should contain an outline of the processes and schedule to review all source categories.

The QA/QC plan is an internal document to organize, plan, and implement QA/QC activities. Once developed, it can be referenced and used in subsequent inventory preparation, or modified as appropriate (i.e. when changes in processes occur or on advice of independent reviewers). This plan should be available for external review.

In developing and implementing the QA/QC plan, it may be useful to refer to the standards and guidelines published by the International Organization for Standardization (ISO), including the ISO 9000 series.

QC should occur throughout the inventory development and document preparation. QA/QC is not separate from, but is an integral part of, preparing the inventory. Based on a national QA/QC plan, source-specific QA/QC plans could be developed for a limited number of sources. QA should occur at 2 stages: an expert review and a public review.

The QA/QC plan itself is intended to be revised and reflect new information that becomes available as the program develops, methods are improved, or additional supporting documents become necessary.

2.1. Management of QA/QC Activities

It is necessary to appoint person responsible for QA/QC activity (QA/QC Manager). This person develops QA/QC plan, and manages the process of quality control and assurance, as well as documents the findings and results of the checks, by completing the Tier 1 checklist and attendant file (*see sub-section 2.2*).

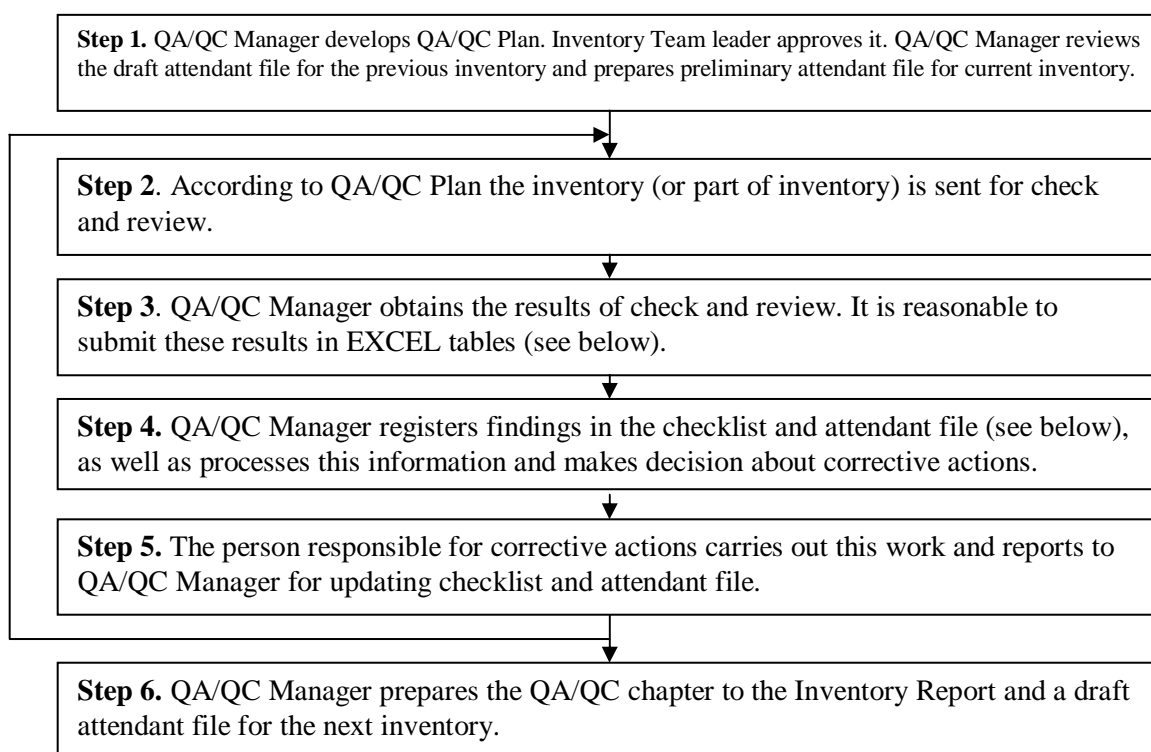
The QA/QC Manager checking quality for inventory should perform ideally the following general activities:

- ✓ Understand the procedures described in the section 3 and the content of *the IPCC Good Practice Guidance* (Chapter 8, Quality Assurance and Quality Control).
- ✓ Check whether spreadsheets for each source category follow these procedures; both general procedures and specific checks are indicated below.
- ✓ Document the findings and results of the checks, by completing the Tier 1 checklist and attendant file, including the summaries of results and problems to be

corrected. The careful documentation is important for potential improvements in the inventory and lightening the work of developers of next inventory.

- ✓ Take any corrective action as needed, documenting (in the appropriate place on the Tier 1 checklist and attendant file) the actions taken and the results.
- ✓ All documentation (including the final completed checklist and attendant file) should be placed in the project file, with copies given to the responsible agencies. Also the draft attendant file for the next inventory should be prepared.

The proposed cycle of QA/QC activity for inventory consists of 6 steps:



2.2. Samples and Templates

The sample of QA/QC Plan (Step 1 of the proposed cycle of QA/QC activity):

| Item | Check/Review | | | Corrective actions | | Comments |
|--|---|------------------|------------------------|---|---------------|----------|
| | Individual (first initial, last name) | Delivery date | Date of performance | Individual (first initial, last name) | Final date | |
| A. DATA GATHERING, INPUT, AND HANDLING ACTIVITIES: QUALITY CHECKS | | | | | | |
| 1. Check a sample of input data for transcription errors | | | | | | |
| 2. Review spreadsheets with computerized checks and/or quality check reports | | | | | | |

| | | | | | | |
|---|--|--|--|--|--|--|
| 3. Identify spreadsheet modifications that could provide additional controls or checks on quality | | | | | | |
| 4. Other (please specify) | | | | | | |
| B. DATA DOCUMENTATION: QUALITY CHECKS | | | | | | |
| 5. Check project file for completeness | | | | | | |
| 6. Confirm that bibliographical data references are included (in spreadsheet) for every primary data element | | | | | | |
| 7. Check that all appropriate citations from the spreadsheets appear in the Inventory Report | | | | | | |
| 8. Check that all citations in spreadsheets and inventory are complete (i.e., include all relevant information) | | | | | | |
| 9. Randomly check bibliographical citations for transcription errors | | | | | | |
| 10. Randomly check that the originals of citations contain the material & content referenced | | | | | | |
| 11. Check that assumptions and criteria for selection of activity data and emission factors are documented | | | | | | |
| 12. Check that changes in data or methodology are documented | | | | | | |
| 13. Other (please specify) | | | | | | |
| C. CALCULATING EMISSIONS AND CHECKING CALCULATIONS | | | | | | |
| 14. Check that all emission calculations are included (i.e., emissions are not hard-wired) | | | | | | |
| 15. Check whether emission units, parameters, and conversion factors are inappropriately hardwired | | | | | | |
| 16. Check if units are properly labeled and correctly carried through from beginning to end of calculation | | | | | | |
| 17. Check that conversion factors are correct | | | | | | |
| 18. Check that temporal | | | | | | |

| | | | | | | |
|--|--|--|--|--|--|--|
| and spatial adjustment factors are used correctly | | | | | | |
| 19. Check the data relationships (comparability) and data processing steps (e.g., equations) in the spreadsheets | | | | | | |
| 20. Check that spreadsheet input data and calculated data are clearly differentiated | | | | | | |
| 21. Check a representative sample of calculations, by hand or electronically | | | | | | |
| 22. Check some calculations with abbreviated calculations | | | | | | |
| 23. Check the aggregation of data within a source category | | | | | | |
| 24. When methods or data have changed, check consistency of time series inputs and calculations | | | | | | |
| 25. Check for consistency with IPCC inventory guidelines and good practices, particularly if changes occur | | | | | | |
| 26. Other (please specify) | | | | | | |
| QUALITY ASSURANCE | | | | | | |
| 27. Expert review of initial data | | | | | | |
| 28. Expert review of emission factors and methodologies | | | | | | |
| 29. Expert review of emission estimates | | | | | | |
| 30. Publication of inventory results | | | | | | |
| 31. Public review | | | | | | |
| 32. Other (please specify) | | | | | | |

The QA/QC Manager proceeds with discretion over how the checks are selected and implemented. Not all checks listed in the sample are necessary. Rows for additional checks that are different in the source category, individual and/or date could be added to the form.

The fragment of completed QA/QC Plan:

| Item | Check/Review | | | Corrective actions | | Comments |
|--|---|------------------|-----------------------|---|---------------|----------|
| | Individual (first initial, last name) | Delivery date | Date of perfomance | Individual (first initial, last name) | Final date | |
| DATA GATHERING, INPUT, AND HANDLING ACTIVITIES: QUALITY CHECKS | | | | | | |

| | | | | | | |
|--|--------------|----------|----------|-------------|----------|------------------------------------|
| 1. Check a sample of input data for transcription errors (Energy) | J. Lennon | 21.06.05 | 30.06.05 | J. Harrison | 05.07.05 | Special attention to carbon stocks |
| 2. Check a sample of input data for transcription errors (Energy) | P. McCartney | 24.06.05 | 02.07.05 | J. Harrison | 07.07.05 | Special attention to fuel stocks |
| 3. Check a sample of input data for transcription errors (Industry+Solvents) | R. Starr | 21.06.05 | 30.06.05 | J. Harrison | 10.07.05 | |
| 4. Check a sample of input data for transcription errors (Agr+LULUCF) | Sting | 24.06.05 | 03.07.05 | J. Harrison | 15.07.05 | |
| 5. Check a sample of input data for transcription errors (Waste) | F. Sinatra | 27.06.05 | 04.07.05 | J. Harrison | 18.07.05 | |
| 6. Review spreadsheets with computerized checks and/or quality check reports (All sources) | R. Newman | 21.06.05 | 08.07.05 | J. Harrison | 25.07.05 | In line with software developer |
| DATA DOCUMENTATION: QUALITY CHECKS | | | | | | |
| 7. Check project file for completeness | D. Wilson | 01.09.05 | 08.09.05 | S. Wonder | 25.09.05 | |
| | | | | | | |

The illustration of the results of check and/or review (Step 3 of the proposed cycle of QA/QC activity):

| | | | | | | |
|---|--------------|-------------|---|--|-----------------------------------|--|
| <p align="center">Summary of results of checks and corrective actions taken:</p> <p>Check a sample of input data for transcription errors (Energy).</p> <p>Check that conversion factors are correct (Energy).</p> <p>Randomly check bibliographical citations for transcription errors (Agr).</p> | | | | | | |
| Person: J. Lennon | | | | Date: 28.06.05 | | |
| File | Sheet | Cell | Error | References | Recommended action | |
| Inv05 | Energy | B15 | Transcription error in coal production (35232 instead of 35323). | Statistical Yearbook, 2005. | To correct data. | |
| Inv05 | Energy | A28 | Coal import (5000 t) differs from IEA data (4825 t). | IEA, 2005. | To correct data according to IEA. | |
| Inv05 | Energy | C57 | Conversion factor for tce (1.15) differs from data of Ministry of Energy (1.14) | Phone consultation with Deputy Minister Mr. M. Planc 15.09.05. | To correct data. | |
| Inv05 | Agr | D15 | Goat population (5600 | FAO, 2005. | To correct data | |

| | | | | | |
|--|--|--|---|--|-------------------|
| | | | heads) differs from FAO data (5555 heads). | | according to FAO. |
|--|--|--|---|--|-------------------|

Proposed template for QA/QC Checklist Tier 1 (Step 4 of the proposed cycle of QA/QC activity):

| Item | Check Completed | | | Corrective actions | | Supporting documents (provide references) |
|--|-----------------|--|-----------------|--------------------|--|--|
| | Date | Individual (first initial, last name) | Errors (Y/N) | Date | Individual (first initial, last name) | |
| The rows of checklist are identical with the rows of QA/QC Plan. | | | | | | |

The sample of the attendant file (Step 4 of the proposed cycle of QA/QC activity):

| Checking person | Date of checking | File | Sheet | Cell | Error | References | Recommended action | Decision | Person resp. for correction | Date of correction | Explanation |
|-----------------|------------------|-------|--------|------|---|--|-----------------------------------|--|-----------------------------|--------------------|--|
| J. Lennon | 28.06.05 | Inv05 | Energy | B15 | Transcription error in coal production (35232 instead of 35323). | Statistical Yearbook, 2005. | To correct data. | To correct data. | J. Harrison | 02.07.05 | |
| J. Lennon | 28.06.05 | Inv05 | Energy | A28 | Coal import (5000 t) differs from IEA data (4825 t). | IEA, 2005. | To correct data according to IEA. | To reject but reserve the discussion for the next inventory. | J. Harrison | 04.07.05 | This problem needs additional investigations on reliability of national statistical data and IEA data. |
| J. Lennon | 28.06.05 | Inv05 | Energy | C57 | Conversion factor for tce (1.15) differs from data of Ministry of Energy (1.14) | Phone consultation with Deputy Minister Mr. M. Planc 15.09.05. | To correct data. | To correct data but reserve the discussion for the next inventory. | J. Harrison | 03.07.05 | It is advisable to find bibliographical citation. |
| J. Lennon | 28.06.05 | Inv05 | Agr | D15 | Goat population (5600 heads) differs from FAO data (5555 heads). | FAO, 2005. | To correct data according to FAO. | To reject. | J. Harrison | 05.07.05 | National statistic on agriculture is quite reliable. |
| ... | | | | | ... | ... | | | | | ... |

The attendant file may consist of separate sheets: for example, general, energy, industry, solvents, agriculture, waste.

QA/QC Manager reaches the decision about undertaken actions. If necessary, QA/QC Manager may consult with Inventory Team Leader.

Those rows, which have record “reserve the discussion for the next inventory” in the column “Decision”, should be moved to the draft attendant file for the next inventory (Step 6 of the proposed cycle of QA/QC activity).

3. Quality Assurance/Quality Control Procedures

3.1. Quality Control Procedures

This chapter describes procedures to be followed both to *control* and to *check* the quality of the inventory estimates and the Inventory Report, and to manage and handle the data associated with the inventory.

Quality Control, as defined by the Intergovernmental Panel on Climate Change (IPCC) in its *IPCC Good Practice Guidance* is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. A basic QC system should provide routine and consistent checks to ensure data integrity, correctness, and completeness, and to identify and address errors and omissions. It should also provide procedures for documenting and archiving inventory material and recording all QC activities.

Following the terminology developed for the *IPCC Good Practice Guidance*, this chapter describes general procedures (Tier 1) that all source categories should follow when gathering, maintaining, handling, documenting, checking and archiving the data, supporting documents, and files (both text documents and spreadsheets) associated with the inventory.

While procedures for maintaining data quality should be followed at all times, not all checks need to be performed always when the inventory is modified. Some activities should be conducted every time (e.g., reviewing electronic data quality checks or inspecting project files for completeness) or at least routinely (e.g., checking that all primary data points in the spreadsheet have citations to references). Some checks need be performed thoroughly once (e.g., checking the entire content of the archives for completeness and consistency) and then only occasionally thereafter. Other procedures or checks are triggered by changes that occur (e.g., changes in assumptions or in the calculation methodology). Budgetary resources will, in part, determine how frequently some checks occur.

A Data Gathering, Input, and Handling

A number of common sense procedures govern the collection, maintenance, and use of electronic and transcribed data for all activity data, emission factors, and other primary data elements. Appropriate procedures can minimize the extent to which errors in data collection occur; various checks on the data and files can further reduce the errors that occur.

Procedures for the Inventory team to follow could include:

- Electronic data should be used where possible to minimize transcription errors.
- Spreadsheet features should be used to minimize user error or entry error:
 - avoid hardwiring factors into formulas;

- create automatic look-up tables or pull down menus that limit permissible entries or, in some cases, automatically enter data;
- use cell protection so that fixed data cannot accidentally be changed.
- If identical data are used by different source categories (e.g., livestock population in categories “Enteric fermentation”, “Manure management” and “Agricultural soils”), the same electronic data file should be used by these source categories.
- It is useful to build in computerized and automated quality checks to highlight possible problems (e.g., to detect outliers, negative values, or missing data; to ensure that values are appropriate to the variable type; etc).
- Data flagged as confidential information should be password protected in the spreadsheets.

The QA/QC Manager (or inventory staff) can perform various hand checks to minimize data input errors. Checks include the following:

- Check for transcription errors among a representative sample of input data by cross checking data against original source, for example, among a sample of parameters used in calculations, activity data, or emission factors.
- Inspect possible problems highlighted by automated checks if available. Automated systems should also be reviewed periodically to ensure that they are functioning properly.

The QA/QC Manager should complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

B Data Documentation

Documentation of the inventory should be sufficiently detailed and clear as to allow an independent but knowledgeable analyst to obtain and review the references used and reproduce the emission estimates. Complete and accessible documentation of methods, spreadsheets, data and data sources is important.

Maintaining Project Files

The Team leader (or leader for a source category) should maintain a complete and separate project file for whole inventory (or for that source category). The intent is that project files should include all the materials the analyst needs to develop the inventory for that year, and that the files should be maintained in a transparent manner. The Team leader has considerable discretion over the form and content of the file (files).

A project file should be maintained for the current inventory and should include all relevant information. The file should contain a list of the names and locations of all “working” spreadsheets, with explanations of links among them, and any recent electronic back-up copies

of working drafts of the spreadsheets. It also should contain Results of check/review with all necessary contact information, copies of reference materials or data. Copies of hand calculations or notes made by the inventory staff, appropriately documented, should be placed in the file. In addition, copies of the checklist completed for QA/QC purposes, together with the attendant file, should be placed in the file.

The QA/QC Manager should check project files for completeness as part of Tier 1 quality control activities. Completed checks should be reported on the QA/QC checklist.

Documenting the Inventory Spreadsheets and the Inventory Report

The inventory staff should ensure that the documentation associated with the inventory is sufficient for an independent analyst to determine the reference source for each piece of data used to calculate emissions, and to locate the data in public sources (if published) or in the project files or inventory archives. The documentation should also provide complete information on any changes that are made to data sources or methodological changes that occur in a given inventory. Both the inventory spreadsheets and the Inventory Report itself should be subject to scrutiny to determine that the references are complete, accurate, and consistent in format. Both the inventory staff and especially QA/QC Manager should be familiar with the following procedures, which are designed to maintain high quality.

In the spreadsheets, every primary data element (activity data, emission factor, etc.) must have a reference for the source of the data. No non-calculated values should appear in the spreadsheets that are not referenced, with the exception of standard unit conversion factors or similar information.

In the spreadsheets, citations to reference sources should be attached by Excel “comments” to the data, or by another system of notation. Abbreviated citations can be used in the comments if full citations appear on a bibliography sheet in the spreadsheet.

Everything—supporting documentation, comments, and especially all printouts made from spreadsheets—should be dated. (Suggestion: set the footer in Excel to include date, and to use the “=TODAY()” function.)

The inventory team and QA/QC Manager can perform various checks to verify the adequacy of the documentation of the spreadsheet.

Among these checks are:

- ✓ Check the spreadsheet for missing citations to the source of data for primary data elements.
- ✓ Check that every reference on the spreadsheet physically exists either in the archives or current project files.

- ✓ In particular, check that contact information in files, facsimiles, diskettes, and/or data printouts and other supporting information exist for unpublished data.
- ✓ Check that assumptions and criteria for selection of activity data are discussed and documented in comment cells on the spreadsheet.

The QA/QC Manager should complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

General documentation of references

To the extent feasible, effort should be made to ensure the documentation follows a uniform format across the inventory spreadsheets.

Individuals, agency, group, or company providing information should be identified by full name, association, phone and fax numbers, and the date information was provided and to whom. Complete bibliographical information should be provided in references.

It is helpful for comments to include the date inserted and/or the name and affiliation of the individual inserting the comment. (Suggestion: set up Excel so that the name of the user is automatically inserted into the comment.)

The QA/QC Manager should review the spreadsheets and the Inventory Report to assess whether the references conform to these requirements. All completed checks should be reported on the Tier 1 checklist.

C Calculating Emissions and Checking Calculations

The Team leader should adopt appropriate procedures for designing and modifying spreadsheets, in order to reduce calculation errors occurring in the emission estimates. A number of checks will help ensure that appropriate procedures have been followed, as well as catch remaining errors. Checks include the following.

- Parameters, emission units and conversion factors for calculations should be clearly labeled and referenced.
- Emission units, parameters, and conversion factors should not be hardwired into formulas; any value used more than once should be included in the spreadsheet (preferably at the head of the page where it first appears and highlighted) and every calculation using that value should reference that cell.
- Maintain the integrity of the database files and spreadsheets:
 - Confirm that the appropriate data processing steps are correctly represented in the spreadsheets (e.g., that the equations are correct).

- Confirm that data relationships are correctly represented in the spreadsheets (e.g., that data are in appropriate and comparable units).
- Clearly differentiate between spreadsheet input data and calculated data (for example, set up and follow a color coding system).
- Check calculations within a source category:
 - Reproduce a representative sample of emission calculations to ensure mathematical correctness.
 - Build in automated checks, such as computational checks for calculations, or range checks for input data, if possible.
- Check that emissions data are correctly (1) aggregated from lower reporting levels to higher reporting levels when preparing summaries and (2) transcribed between different intermediate products.
- Check for temporal consistency in time series input data for each source category and check the method used to fill in gaps in reported data, if possible.
- Check for consistency in the algorithm/method used for calculations through the time series, if possible.
- Check that changes in methods or data are consistent with IPCC guidance on both inventory methods and good practices.

The QA/QC Manager should complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

Coordination on Cross Cutting Activities

It is critical that the QA/QC Manager follows procedures that are designed to reduce errors not only in the inventory estimates for individual source categories, but in the aggregated estimates that are reported, and in the Inventory Report and other documents that report the results of the inventory.

The Team leader is the ultimate owner of the electronic copies of both the linked set of spreadsheets, and the Inventory Report. The source category spreadsheets are not only linked to each other, but each is also linked to a summary worksheet that is used to create the tables in the Inventory Report, and to the Reporting tables.

Some checks are performed for the overall inventory, or require checking data across source categories:

- Checking emission calculations across source categories

- Check that sources using the same input data (e.g., animal population data) report comparable values for the data.
- Check across source categories for identical file references for common data.
- Identify parameters (e.g., activity data, constants, conversion factors) that are common to multiple source categories and confirm that the values used for these parameters are consistent across and within the emission calculations.
- Check that the number of significant digits or decimal places for common parameters, conversion factors, emission factors, activity data and total emissions is consistent across source categories.
- Check that internal documentation is comparable across source categories, e.g., check that spreadsheets and references are consistently documented and procedures are consistently applied.
- Completeness
 - Confirm that estimates are reported for all source categories.
 - Check that known data gaps that result in incomplete source category emission estimates are documented. Gaps resulting from the use of preliminary data, missing data, or proxy data should be documented in cell comments in the spreadsheet.
- Current inventory estimates should be compared to previous estimates, if possible. If there are significant changes or departure from expected trends, re-check estimates and explain any differences.

The QA/QC Manager should complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

3.2. Quality Assurance Procedures

Quality Assurance, as defined in the *IPCC Good Practice Guidance*, comprises a “planned system of review procedures conducted by personnel not directly involved in the inventory compilation and development process.” The quality assurance process commonly includes both expert review and a general public review.

The expert review is conducted in two stages: a review of the initial set of draft emission estimates and, subsequently, a review of the estimates and text of the Inventory Report. In addition, experts are consulted and involved throughout the development of the inventory estimates, providing further review and opportunities for evaluation and assessment of the inventory methodologies and data. The ultimate goal of these expert reviews is to provide an

objective review of the inventory in order to ensure that the final inventory estimates and Inventory Report reflect sound technical information and analysis.

The expert and public reviews each present opportunity to uncover technical issues related to the application of methodologies, selection of activity data, or the development and choice of emission factors. The expert and public reviews of the draft document offer a broader range of researchers and practitioners in government, industry and academia, as well as the general public, the opportunity to contribute to the final document. The comments received during these processes are reviewed and, as appropriate, incorporated into the Inventory Report or reflected in the inventory estimates.

Consistent and thorough procedures should be followed throughout the review processes to ensure the highest quality of the final inventory product. During expert review, careful selection of reviewers, clear instructions for reviewers, tracking the status of reviews, and documenting the review process, the comments that are received, and the responses to those comments, are all part of promoting quality.

Similarly, ensuring that the public review process is open and accessible, and that comments are reviewed and incorporated as necessary in the inventory, is important to ensuring the quality and transparency of the emission estimates and inventory development process. Procedures that are followed for both the expert and the public review processes are described below.

A Expert Review Process

The first expert review is conducted after the initial set of emission estimates is completed. This initial review is relatively informal, and covers the source category emission estimates and totals. Upon request, the experts can review calculations and methodology. The information received at this stage is used to revise the emission estimates so that the draft Inventory will reflect sound technical information and analyses.

Because of the informality of this initial review, the steps and procedures to be followed are relatively simple. The Team Leader along with selects experts for review.

The inventory staff integrates the spreadsheets containing draft estimates for each source category with a summary file, which typically contains a worksheet for each sector and supplemental information.

QA/QC manager prepares instructions for reviewers and distributes these instructions, electronic copies of the source category and total estimates to the reviewers. The Team Leader and QA/QC Manager after receiving the comments reach a decision about appropriate actions.

The second expert review takes place upon completion of the draft Inventory Report. This review draft reflects comments received on the initial emission estimates, and also incorporates the document checks described for the first version of the document. Once the initial draft of the Inventory Report is prepared, reviews are solicited from those who participated in the review of the initial estimates as well as other experts. Comments received at this point are generally in the form of edits to the text, such as suggested language to improve the clarity of definitions or explain the methodologies used, but can also include comments on methodologies and the estimates themselves. This set of comments is evaluated and decisions are made regarding how the remarks may be incorporated into the final draft.

B Public Review Process

By providing an opportunity for all interested parties to review the Inventory, the public review and comment process can further improve the quality of the inventory. A broad spectrum of groups and individuals may participate in the public review, including interested researchers, non-governmental organizations, trade associations, and other interested in the inventory process. The public review process allows parties that might not be readily identified by the expert review, an opportunity to review and comment on the inventory. For these purposes it is necessary to publish Inventory results (e.g., website) to ensure the availability of the draft document.

The QA/QC manager consolidates the comments received into one document; which describes the source of the comment and records the actual comments. Once comments are consolidated, the Team leader together with QA/QC manager, determine whether any changes are necessary to the estimates or text, and record the decision.

C Internal Quality Audits for Tier 1

In perspective, an audit system could be developed to provide additional QA measures. One approach to auditing would be to conduct periodic audits, using internal or external personnel, but excluding the analyst involved in a particular source category. Analysts from other source categories could be used to conduct these audits.

Several types of activities could be conducted during an audit, including duplicating/repeating all the QC procedures, checking the qualifications of staff involved in inventory preparation, checking procedures for project file maintenance, reviewing organizational functions and knowledge of procedures, etc.